GENCO Fuel Cell Powered Lift Truck Fleet Deployment

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GENCO Infrastructure Solutions, Inc.

Project ID: H2RA011

Project Overview

- **Timeline**

  Start: September 15, 2009

  Finish: September 14, 2013

  35% complete (Feb 28, 2011)

- **Budget**
  - Total project funding
    - DOE: $6,060,416
    - GENCO: $6,060,416

- **Barriers**
  - Represents a change in technology, which is met with reluctance
  - Uncertain power unit reliability due to lack of widespread performance data
  - Safety and expense of hydrogen and fueling equipment
  - Difficult to obtain permits and approvals for hydrogen fueling stations

- **Partners**
  - Plug Power – GenDrive power unit and service provider
  - Air Products – Hydrogen supplier
  - Linde – Hydrogen supplier

Relevance

OBJECTIVES

- Support American Recovery and Reinvestment Act goals of long-term economic growth by successfully demonstrating a new technology
- Promoting the economic and environmental benefits of hydrogen fuel cell technology

TACTICS

- Demonstrate the economic benefits of large fleet conversions of lift trucks from batteries to fuel cell power units by measuring, analyzing and reporting on the performance, operability and safety of the systems that will spur further fuel cell lift truck fleet conversions
- Convert electric-drive fork lift truck fleets to fuel cell use in five large distribution centers and manufacturing facilities
- Provide affordable and reliable hydrogen
- Establish a proving ground for hydrogen fueling technology that will promote the future adoption of fuel cells in other applications, such as cars, and help drive the use of fuel cell technology in the United States

Approach

OBJECTIVE

Develop a track record by installing 357 GenDrive power units at five commercial distribution and manufacturing centers

	Wegmans	Whole Foods	Coca-Cola	Sysco Phil.	Kimberly-Clark	TOTAL
Class 1 GenDrive	0	45	40	0	25	**110**
Class 2 GenDrive	36	14	0	25	0	**75**
Class 3 GenDrive	100	2	0	70	0	**172**
TOTAL	**136**	**61**	**40**	**95**	**25**	**357**
Hydrogen Supplier	Air Products	Linde	Linde	Linde	Air Products	

Approach

Critical Path Toward Lift Truck Fleet Conversions

- **Build GenDrive Power Units**
  - Complete the construction of GenDrive fuel cell power units
- **Obtain National Environmental Policy Act (NEPA) Approvals**
- **Install Fueling Stations**
  - Install hydrogen handling and dispensing equipment consistent with merchant liquid hydrogen supply
- **Commission Equipment and Train Personnel**
  - Commission and start up the fueling station and GenDrive power units and train site personnel in their use and maintenance
- **Operate Distribution Centers**
  - Provide operational and maintenance support for the power units and the hydrogen handling and dispensing equipment and evaluate their performance over the duration of the project

Approach

Project Milestones (at December 31, 2010)

	Wegmans	Whole Foods	Coca-Cola	Sysco Phil.	Kimberly-Clark
Fueling Station Operational	Completed	1/31/2011	4/30/2011	4/30/2011	Completed
►GO/NO GO	GO	GO	4/30/2011	4/30/2011	GO
GenDrive Power Units Delivered	136 of 136	61 of 61	10 of 40	4/30/2012	25 of 25
►GO/NO GO	GO	GO	1/15/2011	3/31/2012	GO
Distribution Center Fully Operational	Completed	1/31/2011	4/30/2011	4/30/2012	Completed
Project Complete	9/30/2013	9/30/2013	9/30/2013	9/30/2013	9/30/2013

Accomplishments and Progress

WEGMANS

- Department of Energy (DOE) contract signed in January 2010
- Fueling stations in the produce building completed
- Two new fueling stations in the grocery building and a second compressor completed
- 136 GenDrive power units are running; some units have logged nearly 5000 operating hours
- Wegmans has achieved all project milestones and is pleased with performance of GenDrive power units

SYSCO PHILADELPHIA

- Completion of the fueling station is scheduled for April 2011
- Thirty-four class-3 power units were delivered by March 2011. The remaining 36 class-3 and 25 class-2 power units are scheduled for delivery by April 2012
- Start-up and training is scheduled for May 2011

Accomplishments and Progress

COCA-COLA

- Completion of the fueling station is scheduled for May 2011
- All 40 class-1 power units were delivered by January 2011
- Start-up and training is scheduled for May 2011

KIMBLERY-CLARK

- Installation of the fueling station was completed in December 2010
- All 25 class-1 power units were delivered by December 2010
- Start-up and training was completed by the end of December 2010

WHOLE FOODS

- Installation of the fueling station was completed in January 2011
- All 45 class-3, 14 “order picker” (modified class-2), and 2 class-2 power units were delivered by the end of September 2010
- Start-up and training was completed by the end of January 2011

Technical Accomplishments – Fuel Cells

GenDrive Class-1

Nominal voltage
36 – 48 Vdc
Max. Continuous Power
8.7 - 10.1 kW
Weight
2,260 – 4,000 lbs
Operating Temperature
-25 F – 104 F
Fill Time
180 seconds

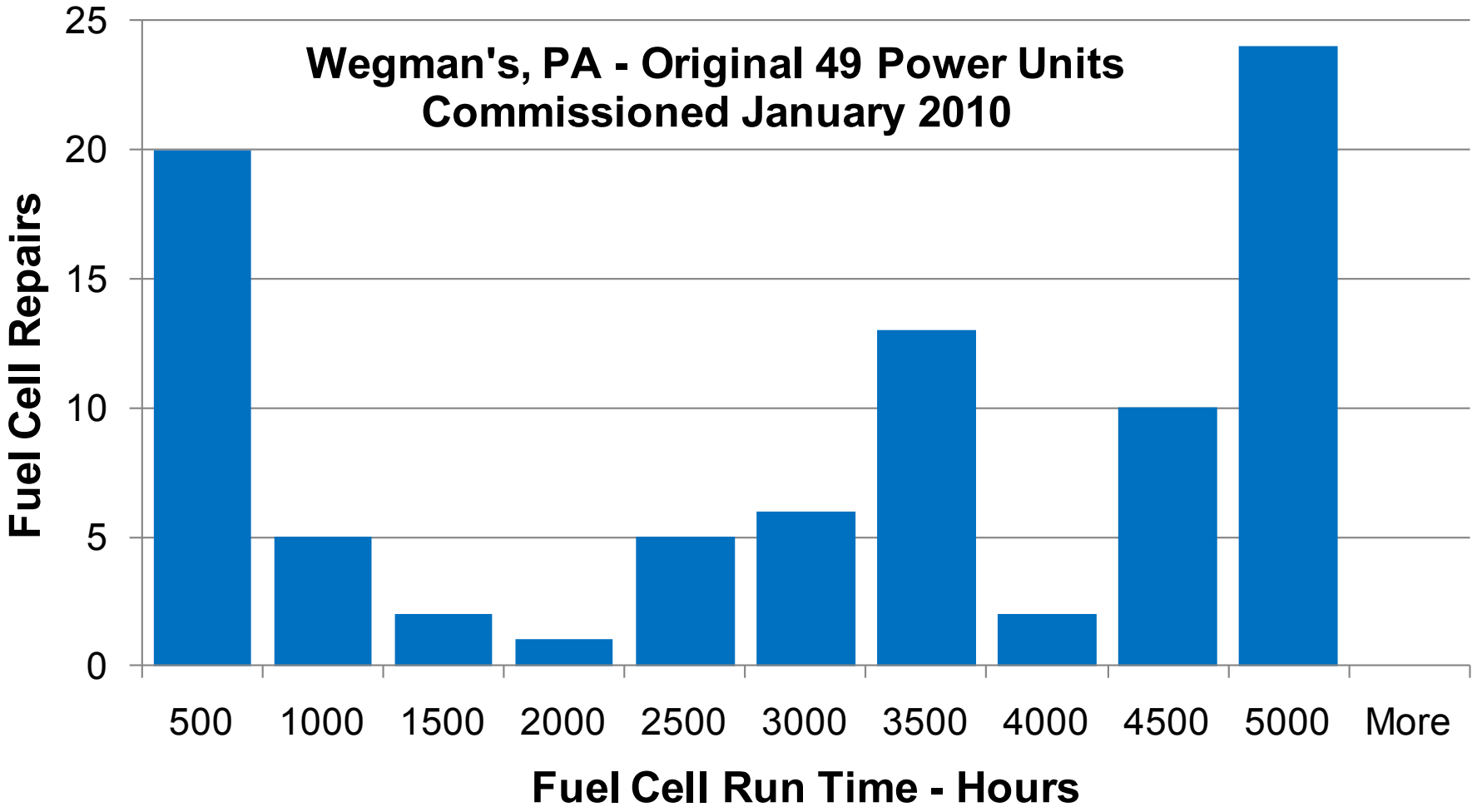
GenDrive Class-2

Nominal voltage
36 Vdc
Max. Continuous Power
10.5 kW
Weight
2,600 lbs
Operating Temperature
-22 F – 104 F
Fill Time
70 seconds

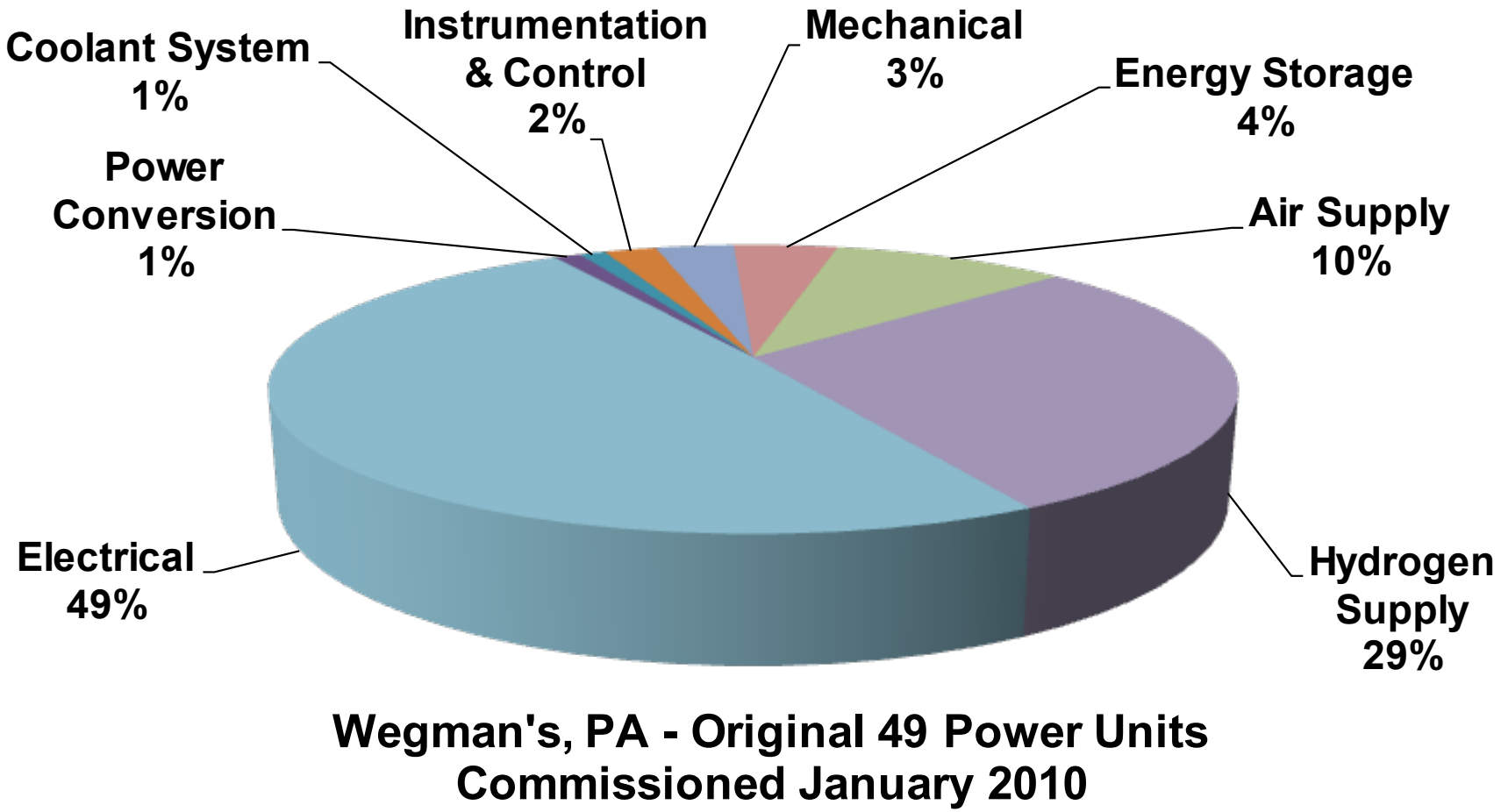
GenDrive Class-3

Nominal voltage
24 Vdc
Max. Continuous Power
2.6 kW
Weight
590 lbs
Operating Temperature
-22 F – 104 F
Fill Time
60 seconds

Fuel Cell Operation - Repair Frequency



Fuel Cell Operation – Types of Repairs



Wegman's, PA - Original 49 Power Units
Commissioned January 2010

Technical Accomplishments – H2

Air Products

- **Wegmans:** First and second phases of the fueling station completed, not part of DOE scope of work
- **Kimberly-Clark:** Installation of the fueling station was completed in December 2010

Linde

- **Coca-Cola:** Completion of the fueling station is scheduled for May 2011
- **Sysco Foods:** Completion of the fueling station is scheduled for April 2011
- **Whole Foods:** Installation of the fueling station was completed in January 2011

Collaborations

- **Partners**
  - Plug Power (Industry) – GenDrive power unit and service provider
  - Air Products (Industry) – Hydrogen supplier
    - Kimberly-Clark
    - Wegmans (not part of DOE scope of work)
  - Linde (Industry) – Hydrogen supplier
    - Coca Cola
    - Sysco Philadelphia
    - Whole Foods (not part of DOE scope of work)

- **Technology Transfer**
  - Collaboration with Plug Power for commissioning of GenDrive power units and service
  - Collaboration with Air Products and Linde for installation of hydrogen fueling systems

Future Work

		Wegmans	Whole Foods	Coca-Cola	Sysco Phil.	Kimberly-Clark
FY10	**Fueling Station Operational**	Completed				Completed
	►GO/NO GO	Completed				Completed
	GenDrive Power Units Delivered	Completed	Completed			Completed
	►GO/NO GO	Completed	Completed			Completed
	Distribution Center Operational	Completed				Completed
FY11	**Fueling Station Operational**		✓	✓	✓	
	►GO/NO GO		✓	✓	✓	
	GenDrive Power Units Delivered			✓	✓	
	►GO/NO GO			✓	✓	
	Distribution Center Operational		✓	✓	✓	

Summary

Relevance: Develop safe hydrogen material handling operations to demonstrate economic benefits and spur future distribution and manufacturing center conversions

Approach: Install Air Products or Linde hydrogen fueling stations at each site, deliver Plug Power GenDrive power units and evaluate operation

Accomplishments: GenDrive power units fully operational at Wegmans and Kimberly-Clark at the end of 2010; remaining power units at all sites will be operational by the end of 2011

Technology Transfer/Collaborations: Plug Power, Air Products and Linde

Future Work: Fueling station installations, GenDrive power unit deliveries, commissioning, training, operation and evaluation